13 Conclusions

13.1 Introduction

The following sections summarise the main conclusions arising from the Environmental Impact Assessment of the Gwynt y Môr project. This concluding chapter is intended to present a brief summary of the project balancing the need for Gwynt y Môr, against the potential environmental effects of the construction, operation and decommissioning of the project in terms of its potential effects (be they adverse or positive) on the physical environment, the biological environment and the human environment.

As is appropriate for the assessment of renewable energy projects, the potential benefits of Gwynt y Môr in terms of the offset of greenhouse gas emissions and the supply of clean electricity from a sustainable and renewable source are also described, providing the balanced EIA view required by Regulators and stakeholders.

It is noted that a realistic 'worst case' approach has been taken for the EIA. This approach follows the principles established by the Rochdale cases and allows for the development of a 'Rochdale Envelope' in order to define the most substantial likely effects on the environment. An assessment of the likely maximum effect is therefore presented whilst allowing the required flexibility to both developer and regulator in finalising the project design. This provides further security in the knowledge that the environmental impact of the development will be no greater than that set out in this ES and may in fact be notably less than is suggested by the 'worst case' assessments.

13.2 The main conclusions of the Gwynt y Môr EIA

The following sections present the main conclusions drawn from Chapters 1 to 12 of this Environmental Statement.

13.2.1 The Proposed Development

Gwynt y Môr is located in Liverpool Bay 13-15 km off the North Wales coast, and 18 km from the Wirral. The project area extends from Prestatyn in the East to Penrhyn Bay in the West. Gwynt y Môr, as defined by the Crown Estate lease, occupies an area of approximately 124 km^2.

Gwynt y Môr will feature between 150 and 250 modern, efficient wind turbines with a maximum project capacity of 750 MWe. As a basis for the EIA and consenting process three layout scenarios have been developed showing the likely minimum and maximum numbers and dimensions of turbines:

- layout scenario 1: 250 x 3 MW class turbines
- layout scenario 2: 147 x 3 MW and 47 x 5 MW class turbines (219 total)
- layout scenario 3: 150 x 5 MW class turbines.

These three layout scenarios have formed the basis for the description of the main offshore components and are considered to provide a realistic range within which the final project design will fall.

It is anticipated that the construction of Gwynt y Môr will commence during 2008. Onshore construction is expected to take up to 2 years, and offshore construction up to 3 years depending on the method of construction used, the availability of construction vessels and the weather encountered.

The main offshore components of Gwynt y Môr will comprise:

- up to 250 wind turbines and towers
- up to 250 foundations for the wind turbines
- up to 4 offshore substations
- power cables between the turbines, between turbines and substations and cables from the wind farm to the shore
- up to 2 pipeline crossings
- up to 5 meteorological masts
- scour protection where appropriate
- ancillary equipment.

The wind turbines installed at Gwynt y Môr will be of a modern, quiet design incorporating three rotor blades attached to a nacelle housing containing the generator, gearbox, and other operating equipment on top of tubular support towers. The final selection and design of the wind turbine foundations and support structures for Gwynt y Môr will be determined as part of the construction contract and procurement process. However the following are under consideration: monopile, multipile, gravity base, and suction caisson.

During the construction phase, an exclusion zone around the construction activity will be required for safety reasons of those on site and other sea users. This will be achieved by applying for safety zones around the offshore structures under the provisions of the Energy Act 2004.

The onshore components of the development comprise:

- onshore cabling from the beach landfall to the onshore substation site
- the onshore substation
- temporary construction laydown yards
- other associated works.

The onshore substation collects the power generated by Gwynt y Môr. The onshore substation will be located at a site to the south of the St Asaph Business Park. Several possible layouts for the substation at this location are being considered and have been assessed.

During the operational phase of Gwynt Môr, there will be a need for small safety zones around each offshore structure (with a radius of 75 metres). These will be applied for under the provisions of the Energy Act 2004 and will ensure the safety of other sea users whilst avoiding any damage to the underwater infrastructure, particularly the subsea cables where they enter the turbine structures.

Gwynt y Môr will be configured to operate with minimal day-to-day supervisory input (with the exception of routine maintenance work). Turbines will be controlled by local microprocessor controls which are in turn monitored by a centralised Supervisory Control And Data Acquisition system (SCADA). Should a turbine develop a fault, this can usually be diagnosed remotely and the turbine shut down automatically for safety purposes.

npower renewables will ensure that the primary concern is the health and safety of all personnel during all phases of the project. All onshore and offshore construction operations will comply with all relevant

legislation and guidance. All project work will follow npower renewables corporate health and safety policy, strengthened by the experience gained from the construction of North Hoyle and the extensive npower renewables generation portfolio.

13.2.2 The need for Gwynt y Môr

The need for renewable energy projects such as Gwynt y Môr is being driven primarily by the need to combat the effects of climate change, brought about by the effects of greenhouse gas emissions (such as carbon dioxide) which is leading to global warming.

The international community's collective response to climate change is embodied in the United Nations Framework Convention on Climate Change. Established at the 1992 UN Conference on Environment and Development which was held in Rio, the Convention sets out an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. Following on from the 1992 convention, the 'Kyoto Protocol' was adopted by the member states in 1997, and ultimately became legally binding in February 2005 following ratification by Russia. This Protocol sets targets and timetables for reducing greenhouse gas emissions from developed countries, with the initial, legally-binding commitments on reductions due by 2008–2012.

The Commitment for the European Union as a whole is to reduce emissions by 8% by 2012, and then by a further 1% per year from 2012 to 2020, with a long term goal of a 70% reduction on 1990 levels (European Commission, 2002).

In March 2000, the UK Government launched its draft Climate Change programme. This programme is designed to meet the UK's commitments under the Kyoto protocol to cut greenhouse gases by 12.5% by 2008–2012 with a cut in CO_2 of 20% by 2010, relative to the 1990 baseline levels. In seeking to achieve these targets and reverse the trends of climate change, the UK Government is committed to supplying 10% of UK electricity from renewable sources by 2010, 15% by 2015 and with an aim of supplying 20% of all electricity from renewable sources by 2020.

To reach the targets for 2010 alone, the rate of build of new renewable plant will need to be of the order of 1250 MW a year for the next seven years, and yet by 2003 only 1200 MW of all renewables excluding hydro-electric had been installed in the UK. There is a consensus that both onshore and offshore wind will need to play a major role if the targets are to be met.

The Welsh Assembly Government endorses and supports offshore wind and recognises its importance in contributing to the achievement of Welsh renewable energy targets. The Welsh Assembly Government policy calls for "a dynamic renewable energy industry" in Wales and has set targets for renewable energy supply of 4 TWh by 2010 which is likely to equate to around 10% of Welsh electricity consumption at that time, and for 7 TWh by 2020.

The UK has potentially the largest offshore wind resource in the world combined with relatively shallow waters. The UK has been estimated to have over 33% of the total European potential offshore wind resource – enough to power the country nearly three times over. The Round 2 offshore wind development process, of which Gwynt y Môr is a major part, has identified 15 sites for development representing a potential total of up to 7.2 GW of electricity generating capacity, equivalent to 7% of UK supply. The continued development of offshore wind farms, therefore, will represent a major contribution towards the Government's 2015 target for renewable generation.

Government policy has clearly and consistently highlighted the vital role of wind energy as a key source of renewable energy in helping to meet the targets set out and in particular the role that offshore wind farms are expected to play in providing the required renewable energy capacity. Diversification of the UK energy supply through the development of renewable sources such as offshore wind farms can bring additional benefits in terms of the security of energy supply and could provide a basis for the development of new industries.

13.2.3 Summary of the environmental impact assessment process

The baseline conditions for the physical, biological and human environment in the vicinity of Gwynt y Môr have been comprehensively described in Chapters 5 to 7 of this Environmental Statement. The potential adverse and positive effects of the Gwynt y Môr Offshore Wind Farm have subsequently been addressed in Chapters 9-12 of this ES. This assessment has considered the construction, operation and decommissioning of the project.

The residual impacts identified through the EIA process are detailed in the following summary sections. The detailed impact assessments are presented in Chapters 9 to 12, including the detailed mitigation and monitoring programmes set out to manage or monitor the potential environmental impacts that might arise as a result of Gwynt y Môr. The assessment has been conducted separately in relation to the offshore and onshore components of the project.

13.2.4 Potential effects of Gwynt y Môr as a source of renewable energy

1 The generating capacity represented by the Gwynt y Môr project has the potential to make a positive contribution to the electricity demands of the UK which is considered to be highly significant.
2 The project provides a **Positive** contribution to tackling the issue of climate change in the UK through the potential reduction of greenhouse gas emissions that might otherwise be produced in the generation of the equivalent capacity from fossil fuel based technologies.
3 Gwynt y Môr has the potential to make a **Positive** contribution to the establishment of a major new offshore industry which Britain is well placed to lead which this assessment considers to be of **Moderate** significance.
4 The project could make a **Positive** contribution to meeting UK local and national government targets in association with the development of other renewable technologies which is considered to be of potentially **High** significance.
5 Gwynt y Môr represents one of the largest Round 2 projects at a generating capacity of 750MWe and in itself will contribute circa 0.6% of total UK energy needs, which equate to a 6% contribution towards the 2010 renewable generation target. This is considered to be **Highly** significant.

13.2.5 The potential effects of the offshore components on physical processes

1 Enhancement to suspended sediment concentrations will be relatively small in magnitude when compared to the existing conditions, temporary in duration and relatively localised. Effects are considered to be of **Negligible** significance.
2 The potential for scour around the buried cables will mitigated through appropriate burial and is considered to be of **Negligible** significance.

3 Scour around the offshore structures will be monitored and where necessary will be mitigated through the use of scour protection and is therefore considered to be of **Low** significance.
4 The effects on the magnitude or direction of the prevailing sediment transport regime are of **Negligible** significance.
5 Effects on the far field wave regime are considered to be negligible to **Low** significance.
6 Impacts on water quality will be appropriately managed and are considered to be of **Negligible** significance.

13.2.6 The potential effects of the offshore components on the biological environment

1 The impacts on benthic habitats arising through construction of the offshore structures or as a result of scour effects are considered to be **Negligible**. The feet of jack-up rigs could also physically disturb the seabed habitats, and their ongoing use through the operational phase is considered to be of **Low** significance.
2 The physical disturbance to seabed and intertidal habitats as a result of cable installation is assessed to be of **Low** significance.
3 The potential for the offshore structures and associated scour protection to provide new surfaces for colonisation promoting habitat and species diversity is considered to be a positive effect which is assessed to be of **Low** significance.
4 Impacts of the installation of the offshore structures on fish and/or shellfish habitat are assessed to be of **Low** significance.
5 The potential impacts of cable installation on fish and shellfish habitats are assessed to be of **Low** significance.
6 The effects of increased suspended sediment concentrations and spoil disposal on the fish and shellfish populations and key habitats of Liverpool Bay are assessed as being of **Low** significance.
7 Noise effects on fish species resulting construction or decommissioning activities at Gwynt y Môr are assessed as being of **Low to Moderate** significance when considering piling activities, with suitable mitigation set out in this respect.
8 Potential electromagnetic field effects on fish arising from the subsea cables are considered to be of **Negligible to Low** significance for most species, but of potentially **Moderate** significance for elasmobranch species. A programme of mitigation, further research and monitoring are set out in this respect potentially reducing this residual effect to **Low to Negligible**.
9 A series of mitigation measures have been set out which will ensure that the effects of noise on marine mammals arising from piling operations would be of **Low to Moderate** significance.
10 The potential impact of noise generated by construction or decommissioning activities interfering with the behavioural use of sound by marine mammals is considered to be of **Low** significance.
11 Impacts on marine mammal prey and feeding as a result of noise generated during construction or decommissioning activities is assessed to be of **Low** significance.
12 The effects of construction, maintenance or decommissioning vessels on marine mammals are considered to be of **Low** significance.
13 The impact of electromagnetic fields produced by the Gwynt y Môr cables on marine mammals is considered to be of **Negligible to Low** significance.
14 The loss of benthic habitat is considered to be of **Low** significance for key bird species such as common scoter.
15 Disturbance to birds caused by the construction, maintenance or decommissioning activities is considered to be of **Low** significance.
16 Displacement effects on species such as red-throated diver, cormorant, shag, common scoter and terns are considered to be of **Low** significance. Effects on other species including fulmar, kittiwakes and other gulls are considered to be of **Negligible to Low** significance. Displacement effects on gannet, manx shearwater and possibly auks are also considered to be **Low** significance.
17 The presence of Gwynt y Môr will not significantly affect the movement of common scoter, red-throated diver or terns so that barrier effects for this species are assessed to be of **Low** significance. Barrier effects on other seabirds such as manx shearwater and gannet are also considered to be of **Low** significance.
18 Collision risk for birds arising from Gwynt y Môr is considered to be of **Low** significance even under storm conditions, given the very low flight height of most of the birds recorded and the distribution of the main populations.
19 The assessment of the potential effects on conservation, including the 'proposed' SPA in Liverpool Bay has concluded that any potential effects on designated conservation sites in or around Liverpool Bay will be of **Low** significance.
20 Effects on rare or protected marine species is assessed to be of **Low to Negligible** significance.

13.2.7 The potential effects of the offshore components on the human environment

1 Gwynt y Môr will result in capital expenditure and effects on the local, regional and national economies. Two scenarios have been developed based on experience from Round 1 offshore construction projects. Using a central case of these scenarios it has been predicted that circa 9% of the total contract value could be sourced locally, with a total expenditure in the UK of circa 66% of the total contract value. This represents a significant **Positive** contribution to the regional economy.
2 The construction of Gwynt y Môr will have a **Moderately** significant **Positive** impact on local employment levels. The decommissioning process will have a **Positive** impact of **Low** significance to the employment levels in the local impact area. The construction phase is predicted to create approximately 1,180 permanent full time equivalent jobs in the UK including around 140 locally.
3 The operation of Gwynt y Môr will result in a **Positive** impact of **Moderate** significance for employment levels in the local area, through the creation of circa 124 jobs either directly or indirectly.
4 A survey of local businesses indicates that many believe that the development of Gwynt y Môr will present opportunities for supply chain development, cluster development and diversification of the local economy. This is assessed as being a potentially **Positive** impact of **Low to Moderate** significance.
5 Effects on offshore recreational activities during the construction and decommissioning stages are assessed to be of **Negligible to Low** significance.
6 Effects on recreational activities during operation of the wind farm are predicted to be of **Negligible** significance as it is expected that yachting, diving and recreational angling will all be able to continue within the operational wind farm.
7 Effects on amenity use and tourism business as a result of cable installation at the beach landfall are assessed to be of **Low** significance.
8 Effects of the construction, operation and decommissioning of Gwynt y Môr on the local tourism industry is considered to be of **Negligible** significance based on the views expressed by tourist visitors during a number of independent surveys. The assessment has concluded that the presence of offshore wind farms, visible from the North Wales or Wirral coasts, is likely to have little or no effect on the attractiveness of the area to tourist visitors.

9 The assessment of the potential effects of the construction, operation and decommissioning of Gwynt y Môr on shipping and navigation has identified a number of potentially significant impacts. These include an increased risk of collision in the shipping lanes to the north of the project area. However, in all cases a series of mitigation has been set out which is considered to reduce the risk to shipping and navigation to an acceptable level, adjudged to be of **Low** significance.
10 The influence of Gwynt y Môr on the existing aids to navigation will be subject to a detailed review as part of the navigational mitigation and as a result the potential impacts are considered to be of **Low** significance.
11 Gwynt y Môr will under certain circumstances have an affect on the operation of ship-borne radar systems. This potential effect has been considered throughout the navigational assessment and in developing the mitigation referred to above. It is noted that some mitigation is available that would reduce the influence of the turbines on radar systems.
12 Impacts on marine radio and navigation systems are considered to be of **Low** significance.
13 The effect on emergency rescue services operating within or adjacent to the project area is considered to be of **Moderate** significance. This is in recognition of the constraints the wind farm could impose on the use of helicopters in search and rescue activities. It is noted that mitigation may be possible in this respect through the amendment of the existing emergency response strategy within the wind farm.
14 The construction or decommissioning of Gwynt y Môr, including the activity of works vessels, could disrupt normal fishing patterns for the small, locally-based commercial and recreational fishing vessels. Mitigation has been set out in this respect and the potential effect is therefore considered to be of **Low to Moderate** significance.
15 Installation of the export cables will have limited effects on the existing patterns of fishing activity and is assessed as being of **Low** significance.
16 The influence of suspended sediment on fish behaviour is considered to be of **Low** significance with regard to the potential effects on associated fisheries.
17 The potential effect of debris or spoil deposited on the seabed during construction or decommissioning is considered to have a potentially significant effect on fishing activity. Mitigation and monitoring in this respect is set out and as a result this effect is considered to be of **Low** significance.
18 During the operational phase, the potential exclusion of the set net fishery pursued by three local vessels from North Wales, should these fishermen choose not to continue fishing within the project area, is considered to be of **High** significance, particularly during the spring/summer months. Effects on other fishing activity are considered to be of **Low to Negligible** significance, with potentially **Positive** benefits for potting and recreational fishermen.
19 Operational vessel movements are assessed to be of **Low** significance with regard to commercial fishing activity.
20 The decommissioning of Gwynt y Môr is considered likely to reverse the predicted impacts on commercial and recreational fishing arising from construction and operation.
21 The predicted effects on commercial fishing, specifically for the three locally based set net fishermen, may have economic consequences.
22 The mitigation set out in respect of navigation and radar systems means that the potential impacts on the operation of the BHP Billiton offshore oil and gas installations are considered to be of **Negligible** significance and potentially beneficial.
23 Gwynt y Môr could interfere with helicopter approaches to the Douglas oil and gas platform in poor visibility and may have the potential restrict the ability of helicopters to climb clear of turbines under one engine inoperative situations in certain wind conditions. npower renewables will continue to consult with BHP Billiton, CHC-Scotia and the Civil Aviation Authority to resolve these potential effects.
24 A programme of mitigation and monitoring has been set out to ensure that adverse effects to the maritime archaeological resource will be of **Negligible to Low** significance with the opportunity for **Positive** effects to occur. Specific mitigation has been set out to safeguard the protected wreck of the Resurgam.
25 The effects of construction noise on coastal populations, specifically from piling operations is predicted to be of **Negligible to Low** significance. A programme of mitigation and monitoring has been set out to ensure that effects at the closest coastal receptors remain within the limits set out by the relevant guidance.
26 Noise arising from the operation of the Gwynt y Môr turbines, in-combination with the other existing or proposed offshore wind farms in Liverpool Bay, is predicted to be below the relevant guideline levels and is considered to be of **Negligible to Low** significance.
27 The potential risk of unexploded ordnance within the project area is considered to be of **Low** significance.
28 The potential visual effects of Gwynt y Môr have been assessed at 36 viewpoints around Liverpool Bay. At the majority of these locations, visual effects are considered to be of insignificant, slight, slight to moderate or moderate. The visual effect from Llandudno Promenade (near Conference Centre) is considered to be of **Moderate to Substantial** significance. The visual effect from Graig Fawr is considered to be of **Moderate** significance.

13.2.8 The potential effects of the onshore components

1 The a programme of mitigation has been set out in relation to the construction of the onshore substation and associated works which will result in impacts on species or habitats of conservation interest which are considered to be of **Negligible to Low** significance.
2 The opportunity for a **Long-term Beneficial Impact** exists by improving the nature conservation value of the hedgerows by re-planting a variety of species of local provenance following installation of the onshore cables.
3 The potential impact on drains and ditches of high local nature conservation value which support species such as otter, water voles and red list breeding bird species is considered to be of **Low** significance.
4 A programme of mitigation has been developed which will ensure that impacts on known or potential unknown features of archaeological interest during the installation or construction of the onshore components will be of **Low** significance.
5 Visual impacts arising from the onshore cable installation will be of **Slight Adverse** significance, with a programme of mitigation set out in this respect.
6 Potential visual impacts associated with the overhead line towers and onshore substation are considered to be **Slight to Moderate** and adverse. Mitigation will reduce the visual impact an acceptable level of **Slight** adverse significance.
7 Noise impacts where cable installation occurs within 200 metres of dwellings located in quiet rural setting, or within 50 metres of dwellings in more urban areas will be of **Low** significance, allowing for the mitigation set out in this respect.
8 Mitigation will be applied during the construction of the onshore substation which will ensure that noise impacts on nearby dwellings will be of **Low** significance.
9 The potential noise impact associated with construction traffic movement and road access and improvement operations is assessed to be of **Low** significance.
10 Appropriate design of the onshore substation will ensure that noise impacts arising from the operation of the substation will be of **Low** significance.

11 Impacts on the local traffic network arising from the installation of the onshore cabling and construction of the onshore substation and associated works will be of **Low** significance, allowing for the mitigation that has been set out in this respect.
12 The impact on amenity use resulting from the installation or removal of the onshore cables at the beach landfall and across country to the onshore substation is assessed to be of **Low** significance. Effects on amenity use of footpaths or bridleways may be subject to some localised and temporary disruption; this is considered to be of **Negligible to Low** significance.
13 Mitigation has been developed in order to ensure that the flood risk that might result from the installation of the export cables below the coastal defence will be of **Negligible** significance.
14 The construction of the onshore components will result in permanent land-take but this is considered to be of **Low** significance given the relatively low-quality nature of the land occupied.

13.2.9 The potential cumulative and in combination effects

In addition, the potential for cumulative effects arising as a result of Gwynt y Môr acting in-combination with other existing or proposed plans, projects or activities have been considered in relation to the physical, biological and human environments and covering both offshore and onshore aspects of the project. In almost all cases, such effects are considered to be insignificant as a result of the spatial or temporal limitations of the site-specific impacts or as a result of the site-specific mitigation and management that has been set out in relation to Gwynt y Môr. For example, no significant cumulative effects are anticipated in relation to bird populations, marine mammal species or sites of nature conservation interest (including those designated under European wildlife legislation).

However, additional, potential cumulative effects have been identified in a limited number of cases, which are summarised as follows:

1 Gwynt y Môr will act in-combination with the other existing and proposed offshore wind farms in the eastern Irish Sea and elsewhere around the UK coasts. These projects will make a significant cumulative contribution to the provision of clean, sustainable and renewable electricity, the reduction of the emission of greenhouse gases and to meeting UK Government and regional policies.
2 Cumulative socio-economic benefits may also arise as a result of the multiple offshore wind farm developments in the Liverpool Bay region which could bring significant benefits to the North Wales and North West regions in terms of investment and employment opportunities.
3 Potentially significant effects on offshore recreational activities could occur during the construction or decommissioning phase where Gwynt y Môr acts in-combination with the existing shipping to the north of the project area. For example, in the case where the construction safety zones mean that recreational craft have to navigate within the busy shipping lanes to the north. However, mitigation and management of this issue is set out which, when combined with the site-specific mitigation for navigation, will reduce the significance of this effect to an acceptable level.
4 The potential effective exclusion of some commercial fisheries from the operational turbine array would act in-combination with the range of other activities in Liverpool Bay to further reduce the area available for some commercial fishing, most notably the set net fishery, but also possibly more mobile trawling fisheries. This issue would be considered in developing the site-specific mitigation programme set out in respect of commercial fisheries.
5 With regard to the cumulative visual impacts, the effects of Gwynt y Môr in-combination with North Hoyle, Rhyl Flats and Burbo Bank Offshore Wind Farms has been considered in relation to the most recent guidance from the DTI. In some cases, the cumulative effects are no less or greater than for the assessment of Gwynt y Môr alone. In a number of cases, and based on the recent guidance, the introduction of the Round 1 offshore wind farms, such as Rhyl Flats, is taken to reduce the sensitivity of the existing seascape to Gwynt y Môr, so that the in-combination effects are less than those indicated by the site specific assessment. One such case is at Llandudno.

13.3 Concluding statement

The Environmental Statement demonstrates a strong need for the Gwynt y Môr Offshore Wind Farm as a significant source of clean, renewable and sustainable energy for Wales and the North West of England. The generation from the Gwynt y Môr project has the potential to satisfy the domestic electricity demand of 500,000 homes, equivalent to over 40% of the domestic electricity demand in Wales.

Furthermore, the project is entirely consistent with the drive, direction and the strong commitments, made as part of European and UK National Government policy. This is in respect of the need and desire to combat the effects of climate change by seeking clean and sustainable sources of renewable energy supply to meet 10% of UK demand by 2010 and 15% by 2015 as set out by UK Government. Such commitments are also embodied in the policies of the National Assembly for Wales and reflected in local planning guidance.

Equally, it is clear that even where significant renewable energy projects are required, desired and form key parts of policy for the reduction of greenhouse gas emissions, these must be balanced by reasonable environmental and social cost. The Environmental Statement has, therefore, investigated the potential impacts of the scheme through a detailed EIA process.

The Gwynt y Môr EIA has identified a number of areas where potentially significant effects might arise. These include potential effects on marine mammals due to noise during piling activities, potential effects on the safety of navigation for commercial and recreational vessels, on the commercial fishing industry (specifically North Wales based set net fisheries), the safety of operations at the BHP Billiton oil and gas installations (specifically helicopter operations), and the seascape and visual effects at selected viewpoints. However, in nearly all cases suitable mitigation is proposed which is adjudged to reduce or manage the residual significance of these potential impacts to a level considered to be acceptable.

Potentially significant visual impacts occur at a limited number of the viewpoints considered, notably at Llandudno. It is noted, however, that when considered in-combination with the other offshore wind farms in the region (notably Rhyl Flats) the significance of Gwynt y Môr on these viewpoints is reduced. In addition, it is noted that visual impacts are generally considered to be a matter of subjective judgment. Gwynt y Môr is positioned outside of the 13 km offshore exclusion zone imposed by the DTI in part in seeking to reduce visual sensitivity to Round 2 projects. The western boundary of the Gwynt y Môr turbine array has been also been amended by npower renewables in seeking to reduce potential impacts on the Great Orme and Snowdonia. Independent surveys of the local populations seeking views on both North Hoyle and Gwynt y Môr, suggest that the majority of the local population are supportive of both projects.

In relation to the benefits of the project, the Gwynt y Môr EIA has identified a number of potentially positive impacts. Most significant amongst these are the contribution to reducing greenhouse gas emissions, producing a clean sustainable source of energy, and contributing to the diversity and security of energy supply, in line with UK Government policy. Positive impacts may also arise through the creation of jobs and

the generation of investment in the local, regional, and national economies for marine animals through the introduction of new structures suitable for colonisation and through the attraction of fish to the area.

The environmental and social costs of the scheme have, generally been assessed to be of low significance and at a level considered to be acceptable. Where potentially significant effects have been noted suitable mitigation has been developed which will reduce the significance of those effects.

In conclusion, the clear need for the Gwynt y Môr Offshore Wind Farm and the associated benefits that it could provide, balanced by the low environmental and social costs of the scheme, suggests that Gwynt y Môr should be subject to consenting for all aspects, but with due consideration of the mitigation and monitoring developed through the EIA process and set out in detail in the preceding chapters.

Figures

7 The existing human environment

12.6 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 5 Red Wharf Bay

12.7 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 13 Great Orme

12.8 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 16 Llandudno Promenade.

12.9 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 18 Llandudno, beach paddling pool.

12.10 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 19 Rhos-on-Sea.

12.11 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 19 Rhos-on-Sea.

12.12 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 21 Mynydd Marian.

12.13 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 21 Mynydd Marian.

12.14 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 22. Abergele, Pensarn station.

12.15 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 22. Abergele, Pensarn station.

12.16 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 25 Prestatyn Bova Centre.

12.17 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 25 Prestatyn Bova Centre.

12.18 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 26 Prestatyn Hillside, Gwaenysgor.

12.19 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 26 Prestatyn Hillside, Gwaenysgor.

12.20 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 30. Hilbre Point.

12.21 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 30. Hilbre Point.

12.22 Predicted cumulative view – 5 MW Class Turbines with Round 1 Wind Farms. Viewpoint 32. Crosby.

Abbreviations

ADCP Acoustic Doppler Current Profiler

ADT Acoustic Deterrent Device

AIS Air-insulated substation

AIS Automatic Identification System

AL Advisory Leaflet

ALC Agricultural Land Classification

ALV Area of Landscape Value

AOD Above Ordnance Datum

AONB Area of Outstanding Natural Beauty

AOSP Area of Special Protection

ARA Airborne Radar Approach

ASCOBANS Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas

ATSSD Air Traffic Services Standards Department

AWAC Acoustic Wave and Current

AWCSS All Wales Common Scoter Survey

BACI Before-After-Control-Impact

BGS British Geological Survey

BLW Broad-leaved Woodland

BMAPA British Marine Aggregate Producers Association

BMT British Maritime Technology

BOD Biological Oxygen Demand

BP Before Present

BRC Background Reference Concentration

BSAC British Sub-Aqua Club

BWEA British Wind Energy Association

CAA Civil Aviation Authority

CA Cruising Association

CA-OWEE Concerted Action on Offshore Wind Energy in Europe

CCBC Conwy County Borough Council

CCW Countryside Council for Wales

CDM Construction Design and Management

CEFAS Centre for Environment, Fisheries and Aquaculture Science

CFC Chlorofluorocarbon

CFCM Coastal Fisheries Conservation and Management

CHA Competent Harbour Authority

CITES Convention on International Trade in Endangered Specis

CMACS Centre for Marine and Coastal Studies

COD Chemical Oxygen Demand

COLREG Collision Regulations

COWRIE Collaborative Offshore Wind Research into the Environment

CPA Closest Point of Approach

CPA Coast Protection Act

CPT Cone penetrometer test

DAP Directorate of Airspace Policy

DCC Denbighshire County Council

DCWW Dwr Cymru Welsh water

Defra Department for Environment, Food and Rural Affairs

DETR Department of the Environment, Transport and the regions

DfT Department for Transport

DGA Dissolved Gas Analysis

DoE Department of the Environment

DP Dynamic Positioning

DTI Department for Trade and Industry

EAS Environmental Advisory Service

EC European Commission

ECDIS Electronic Chart Display Information systems

EIA Environmental Impact Assessment

EISDG East Irish Sea Developers Group

EM Electromagnetic

ES Environmental Statement

ESA Environmentally Sensitive Area

ETSU Energy Technology Support Unit

ETV Emergency Towing Vessel

FAD Fish Aggregating Device

FEPA Food and Environment Protection Act

FLO Fisheries Liaison Officer

FLOW Fishing Liaison with Offshore Wind

FLR Fisheries Liaison Representative

FSU Fisheries Statistical Unit

FTE Full-time Equivalent

GBS Gravity Base Structure

GIS Gas-insulated substation

GIS Geographic Information System

GLA General Lighthouse Authority

GMDSS Global Maritime Distress and Safety System

GPS Global Positioning Systems

GRC Geological Conservation Review

GSA Guide to Seascape Assessment

GtC Gigatonnes of carbon

GVA Gross Value Added

GW Gigawatt

ha Hectare

HAT Highest Astronomical Tide

HCFCs Hydrochlorofluorocarbons

HDPE High-density Polyethylene

HDTAGWQ Habitats Directive Water Quality Technical Advisory Group

HF High Frequency

HGV Heavy Goods Vehicle

HSE Health and Safety Executive

HW High Water

IALA International Association of Lighthouse Authorities

IMO International Maritime Organisation

IPCC Intergovernmental Panel on Climate Change

ISQG Interim Sediment Quality Guidelines

JNCC Joint Nature Conservation Committee

km kilometre

kWh kilowatt hour

LAT Lowest Astronomical Tide

LBAP Local Biodiversity Action Plan

LF Low Frequency

LGV Light Goods Vehicle

LLA Local Landscape Areas

LV Low Voltage

m metre

MAB Man and Biosphere

MAFF Ministry of Agriculture, Fisheries and Food

MARPOL International Conventions for the Prevention of Pollution from Ships

MCA Maritime and Coastguard Agency
mCD metres, relative to Chart Datum
MCEU Marine Consents and Environment Unit
MDHC Mersey Docks and Harbour Company
MDPE Medium-density Polyethylene
Met Office Meteorological Office
MF Medium Frequency
MHWM Mean High Water Mark
MHWS Mean High Water Springs
MIPPS Ministerial Interim Planning Policy Statement
MNR Marine Nature Reserve
MoD Ministry of Defence
MPA Marine Protection Area
MRCC Maritime Rescue Co-ordination Centre
MRSC Maritime Rescue Sub-Centre
MSL Mean Sea Level
MW Megawatt
MW Microwave
NATS National Air Traffic Service
NCR Nature Conservation Review
NERC National Environment Research Council
NERI National Environmental Research Institute
NFFO National Federation of Fishermen's Organisations
NGO Non-governmental Organisations
NGT National Grid Transco
nm Nautical Mile (1 nm = 1,852 metres)
NMMP National Marine Monitoring Programme
NNR National Nature Reserve
NOREL Nautical and Offshore Renewables Energy Liaison
NTM Notice to Mariners
NWNWSFC North Western and North Wales Sea Fisheries Committee
OBS Optical Back-Scatter
ODPM Office of the Deputy Prime Minister
ORCU Offshore Renewables Consents Unit
OREI Offshore Renewable Energy Installations
OSI Oil Storage Installation
OSL Optically Stimulated Luminescence
OSPAR International convention addressing all sources of Pollution which might affect the Maritime Area
OWF Offshore Wind Farm
PAH Polyaromatic Hydrocarbon
P&O Peninsular and Oriental Steam Navigation Company
PCB Polychlorinate Biphenyl
PCP Pollution Control Plan
PEL Probable Effects Level
PIU Performance and Innovation Unit
POL Proudman Oceanographic Laboratory
PPW Planning Policy Wales
PSA Particle Size Analysis
PTS Permanent Threshold Shift
RAG Research Advisory Group
RBL Radio Broadcast Link
REZ Renewable Energy Zone
RNLI Royal National Lifeboat Institution
ROC Renewables Obligation Certificate
ROFI Regions of Freshwater Influence
RO/RO Roll-on/Roll-off
ROV Remotely Operated Vehicle
RSPB Royal Society for the Protection of Birds
RTC Rhyl Town Council
RYA Royal Yachting Association
SAC Special Area of Conservation
SAR Search and Rescue
SCADA Supervisory Control and Data Acquisition
SCR Seabird Colony Register
SEA Strategic Environmental Assessment
SEMP Site Environmental Management Plan
SF6 Sulphur Hexafluoride
SFC Sea Fisheries Committee
SFF Scottish Fishermen's Federation
SFI Sea Fisheries Inspectorate
SMA Sensitive Marine Area
SMRU Sea Mammal Research Unit
SOLAS Safety of Life at Sea
SPA Special Protection Area
SSC Suspended Sediment Concentration
SSSI Site of Special Scientific Interest
STATCOM Static Reactive Power Compensator
STC Sensitivity Time Control
STCW Seafarer's Training, Certification and Watchkeeping
SUDS Sustainable Drainage Systems
SVC Static Var Compensator
SWAN Simulating Waves in the Nearshore (wave model)
TAN Technical Advice Note
TCPA Town and Country Planning Act
te Metric Tonne
TEL Threshold Effects Level
THLS Trinity House Lighthouse Service
TOC Total Organic Content
TPOD Towed Porpoise Detector
TTS Temporary Threshold Shift
TWh terrawatt hour
UDP Unitary Development Plan
UHF Ultra-High Frequency
UK United Kingdom
UK CCP UK Climate Change Programme
UKCIP UK Climate Impacts Programme
UKHAP UK Habitat Action Plan
UKHO United Kingdom Hydrographic Office
UKSRR United Kingdom Search and Rescue Region
UNCLO United Nations Convention on the Law of the Sea
UNESCO United Nations Educational, Scientific and Cultural Organisation
UPS Uninterruptible Power Supply
UPVC Unplasticised Polyvinylchloride
VAW Visual Assessment of Wind Farms
VHF Very High Frequency
VTS Vessel Traffic Services
WDA Welsh Development Agency
WFD Water Framework Directive
WHO World Health Organisation
WSI Written Scheme of Investigation
WT Wildlife Trust
WTB Wales Tourist Board
WTG Wind Turbine Generator
WWF World Wide Fund for Nature
WWT Wildfowl and Wetlands Trust
ZTV Zone of Theoretical Visibility

Glossary

Acoustic impact model Conceptual and numerical models that compute how sound travels through the water, taking into account variables such as water temperature, salinity, bottom topography, etc.

Acoustic masking Loss of perception of one sound source because of another louder source.

Airborne noise Noise radiated directly from a source, such as a loudspeaker or machine, into the surrounding air.

Algae Chiefly aquatic, one-celled or multicellular plants without true stems, roots and leaves.

Alien species Species that do not naturally occur within an area and that have usually arrived in an area as a result of human intervention.

Alluvium Sedimentary material deposited by flowing water.

Ambient noise The totally encompassing noise in a given situation at a given time; it is usually composed from many sources, near and far.

Amphipods small, prawn like crustaceans

Anadromous Fish that hatch rear in fresh water, migrate to the ocean to grow mature and migrate back to fresh water to spawn and reproduce.

Anthropogenic Of human origin or cause.

Audibility The ability of a sound to be heard: a subjective criterion for setting limits to noise levels.

A-weighting Weighting of the audible frequencies designed to reflect the response of the human ear to noise. The ear is more sensitive to noise at frequencies in the middle of the audible range than it is to either very high or very low frequencies. Noise measurements are often A-weighted (using a dedicated filter) to compensate for the sensitivity of the ear.

Background Noise Level Defined in BS 4142 as the LA90 of the residual noise (see under residual noise).

Baleen Whales/mysticetes Filter feeding whales that use baleen plates to filter out food items from water.

Beam trawling Bottom trawl that is kept open laterally by a rigid beam. Each end of the beam is attached to the apex of a roughly triangular metal 'trawl head' or 'shoe' ca 0.5–0.75 m high.

Beaufort force a number denoting the speed (or strength) of the wind according to the Beaufort wind scale

Bedload Sediment or other material that slides, rolls or bounces along a stream or channel bed of flowing water.

Before Present (BP) The time of an event relative to the present day.

Benthos/benthic Relates to the habitats and species assemblage on the sea floor.

Biotope small area with uniform biological conditions (climate, soil, altitude etc.)

Broadband A noise containing a wide range of frequencies.

Broadleaved woodland Wooded land on which more than 75% of the tree crown cover consists of broad leafed species.

Bubble curtains The use of bubbles i.e. from a bottom-resting bubbler manifold supplied with compressed air, around a marine construction site to reduce the velocity and attenuation of acoustic waves.

Catadromous refers to fishes that migrate from fresh water to salt water to spawn or reproduce.

Cephalopod A mollusc having a distinct head with prehensile and locomotive organs attached e.g. octopus, squid

Cetacea Order name for all species of whales, dolphins and porpoises. The common use of this term is cetacean.

Circa littoral The region dominated by sessile animals, found below the algal zone.

Clupeids Fish of the herring family Clupeidae e.g., herrings, sardines.

Cone penetrometer test CPT measurements can be used to delineate soil types and soil permeability.

Crustacea A group of small animals with two pairs of antennae and a calcium carbonate exoskeleton e.g. crab, lobster.

dBA Decibels A-weighted.

dBht (species) Perceived hearing threshold levels for various marine species, which are suitable for investigating the characteristics of underwater noise and for estimating the behavioural response.

Decibel Units of sound measurement and noise exposure measurement.

Demersal Marine life found at or near the sea bed.

Devensian The last glacial period (or Ice Age) of the Pleistocene in Britain, between about 80,000 years ago and 10,000 years ago.

Diadromous Organisms that migrate between fresh and salt water.

Diatom Major group of phytoplanton whose cells are enclosed in shells.

Dinoflagellate Single celled Algae, mainly marine and often with a cellulose shell.

Dolphin A water mammal with a long snout that is a small member of the whale group.

Drifting ship scenario A situation in which a vessel (ship, boat or other waterborne craft) has lost the ability to control its speed and direction (e.g. loss of power) and its progress is determined by the effect of the wind, tide and current.

Echolocation Location of objects and surfaces by sensing the reflection of sounds.

Elasmobranch Fish with cartilaginous, non bony skeleton, e.g. sharks.

El Nino A major warming of the equatorial waters in Pacific Ocean. El Nino events usually occur every 3 to 7 years, and are characterised shifts in normal weather patterns.

Enteromorpha A strand like or tubular green algae.

Ephemeral An organism that has a short life cycle.

Epi-benthic On top of the seabed.

Epifauna Organisms living on a surface e.g. the bay bottom or submerged leaves of a rooted aquatic plant.

Equivalent continuous sound pressure level (LAeq, t) A measure of the average sound pressure level during a period of time, in dB(A) weighted.

Eulittoral The marine intertidal zone subject to wave action

Eustatic change Sea level changes that affect the whole Earth.

Frequency (Hz) The pitch of the sound, measured in Hertz.

Fundamental frequency The lowest natural frequency of a vibrating system.

Gadoids Fish of the family of Cod, includes haddock, and hake.

Gravity base A large diameter steel or concrete base foundation, which relies on the weight of the structure to ensure that horizontal loads will not cause any upward forces on the base. Downward forces are resisted by the base bearing onto the seabed.

Greenhouse gas Any gas that absorbs infra red radiation in the atmosphere.

Groundborne Noise perceived by the sense of hearing that differs from noise in general only insofar as it arrives in the space where is it heard as a result of propagation as vibration (at acoustic frequencies) through the ground or through a structure.

Habituate Being accustomed or used to a potential disturbing stimulus such as vessel noise.

Harmonic A signal having a repetitive pattern.

Hearing threshold shift Change in the intensity of the quietest sound that can be heard by an individual. The change can be temporary and returns to normal or permanent resulting in hearing loss.

Holocene A period of geological time extending from 10,000 years BP until present day.

Hydrophone Microphone that can be used underwater.

Hz Hertz The unit of frequency.

Impulsive noise Any type of single or repeated noise of short duration, e.g. the noise from an explosion or the noise of a power press.

Index of Multiple Deprivation Measure of deprivation that takes into account a range of factors relating to income, employment, health, housing, access to services, and child poverty.

Infaunal Relates to animals living within (sediment).

Infralittoral The algal dominated zone below low water mark.

Intertidal The zone between high and low tide.

Isopod Any of a large order of sessile-eyed crustaceans with the body composed of seven free thoracic segments each bearing similar pair of legs.

Jack-up Barge A floating vessel that typically has between four and eight legs which can lower its legs to the seabed and jack up to create a stable platform.

J-tubes Steel tubes which run from the bottom a offshore wind turbines tower down the support structure and bend outwards in a j shape, ending at the seabed in a wide bell-mouth. J-tubes allow the inter-turbine cables to be fed into the main turbine support structures and connected to the cables in the turbine tower. They are also used for cable connections into the offshore substations.

LA eq Equivalent average sound level measured using the A weighting which is most sensitive to speech intelligibility frequencies of the human ear.

LA max Maximum value of the A-weighted sound pressure level, measured using the fast (F) time weighting in dB(A).

LA90 This is the noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during quieter periods. It is often referred to as the background noise level and is used in the assessment of disturbance from industrial noise.

Leq See 'Equivalent continuous sound pressure level'.

Lichen An organism consisting of an outer fungal body enclosing photosynthetic algae.

Littoral drift The process by which sediment is transported along the shore.

Loudness The measure of the subjective impression of the magnitude or strength of a sound.

Lowest Astronomical Tide The lowest level of tide that can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions.

Macrobenthic Benthic organisms (animals or plants) whose shortest dimension is greater than or equal to 0.5 mm.

Megaripple A bedform which has its crestline orientated transversely normal to the direction of the maximum tidal current and which has a wavelength of 1–10 m and a height of 0.1 m to 2 m.

Monopile Welded steel tube foundation, which is driven and/or drilled vertically into the seabed. They support the weight of the tower and turbine, primarily by using friction between the pile walls and the seabed.

Multipile Foundation that typically consists of a large vertical steel tube located centrally under the main turbine tower, supported by a three-leg frame of smaller steel tubulars. Small diameter piles are driven through a pile sleeve at each leg and connected to the legs using a grouted connection. The weight of the turbine and its support structure is resisted by the friction between the sediment and the pile walls.

Noise spectrum A noise represented by its frequency components.

North Atlantic drift Oceanic current running west to east across the North Atlantic and driven by the Gulf Stream. This current has a warming influence on the weather and conditions of maritime northern Europe.

Octave The range between two frequencies whose ratio is 2:1.

Odontocete Group name for cetaceans that have teeth or vestigial (redundant and diminutive) teeth.

Otter trawl A demersal trawl that is held open laterally by otter boards or 'doors'.

Peak particle velocity Peak particle velocity is defined as 'the maximum instantaneous velocity of a particle at a point during a given time interval', and has been found to be the best single descriptor for correlating with case history data on the occurrence of vibration-induced damage.

Pelagic Marine life found in the water column.

PH (Potential of Hydrogen) The logarithm of the reciprocal of hydrogen concentration in gram atoms per litre; provides a measure on scale from 0 to 14 of the acidity or alkalinity of a solution.

Phocoenidae Family name for the porpoises.

Phytoplankton bloom a high concentration of phytoplankton in an area caused by increased reproduction.

Pilot whale Small dark coloured whale of the Atlantic coast.

Pinnipedia Group name for all species of seals, sealions and walruses. The common use of this term is pinniped.

Planktonic Open water habitat.

Porpoises Smallest of the toothed cetaceans and physiologically different based on skull and dental (tooth) features, including spade-like teeth as opposed to simple conical teeth.

Polychaete A type of marine worm.

Preservation by record The preservation of an archaeological site by recording it through excavation, analysis, curation, and publication.

Quaternary The last two million years of geological time, comprising the Pleistocene and Holocene glacial epochs. Estimates of the date of the beginning of the Quaternary vary between 2.5 and 1.6 million years ago.

RAMSAR site Wetlands designated by the contracting parties of the Ramsar Convention for inclusion in the list of wetlands of international importance because they meet one or more of the Ramsar criteria.

Rating level A noise index defined in BS 4142 and BS 7445, as the equivalent continuous Aweighted sound pressure level during a specified time period, adjusted for tonal and impulsive characteristics of the sound.

Red list Wetland site listed under the convention of wetlands adopted following an international conference in Ramsar Iran 1971.

Red tide red coloration, usually of coastal waters, caused by large quantities of microscopic organisms (generally dinoflagellates); some red tides result in mass fish kills, others contaminate shellfish, and others produce no toxic effects.

Residual noise The ambient noise remaining when the specific is suppressed, defined in BS41 42 and BS 7445.

Root mean square For the sound or vibration waveform the RMS value over a given period is the square root of the average of the square of the waveform over that time period.

Ruderal Disturbed, weedy sites, pertaining to human cultivation or disturbance.

Sand bank A submerged bank of sand near a shore or estuary mouth; can be exposed at low tide.

Sand ribbon Elongate features of low relief, typically straight of slightly curved. Commonly less than 10 m thick with widths of tens of metres.

Sand wave Asymmetric bedform (like underwater dunes) with crest commonly found in sand wave fields although they can be found as isolated or randomly spaced. Sand wave heights are generally between 3 m and 15 m with wavelengths of 30 m–500 m.

SCADA system A system control and data acquisition system which allows the remote monitoring and control of plant such as wind turbines.

Sheet flow Flow that occurs overland in places where there are no defined channels, the flood water spreads out over a large area at uniform depth – overland flow.

Sightability The chances of seeing a marine mammal during a survey.

Sightings indices Value estimating the number of animals seen per unit of effort spent watching.

Soft start Commencement of noisy procedure with low energy release and building gradually and uniformly to operational levels.

Sound exposure level (LAE) The total sound energy of a noise event compressed into a unit time period, ie one second.

Sound power The sound energy radiated per unit time by a sound source, measured in watts.

Sound power level Lw (SWL) Sound power measured on a decibel scale.

Sound pressure The fluctuations in air (or water) from the steady state pressure, created by sound and measured in Pascal's.

Sound pressure level (SPL) The basic measure of noise expressed in decibels, referenced to 1µ (micro) Pascal (Pa) for underwater acoustics or to 20 µ Pa for in-air acoustics. Usually measured with an appropriate frequency weighting, e.g. A-weighting for in-air sound propagation.

Spatfall The settlement of fertilised shellfish larvae e.g. of oysters or mussels onto suitable substrates.

Specific noise The particular component of the ambient noise, which is under consideration or investigation, e.g. in connection with a planning application or noise complaints; defined in BS4142.

Steady noise Noise from which the fluctuations in time are small enough to permit measurements of average sound pressure level to be made satisfactorily without the need to measure Leq using an integrating sound level meter (defined in BS4142)

Stratification Layering of the water column caused by differences in temperature or salinity.

Sublittoral Below tide level, marine.

Subtidal The portion of tidal environment that lies below the level of mean low water for spring tides. Normally it is covered by water at all stages of the tide.

Suction caisson Foundation Steel or concrete foundation similar to a gravity base (but smaller in diameter) which relies on sediment within the caisson to ensure that horizontal loads will not cause any upward forces on the caisson. Downward forces are resisted by friction between the skirts and the sediment and the bearing of the top plate of the base onto the seabed.

Suspended load A body of fine, solid particles, typically of sand, clay and silt the travels with stream water coming in contact with the stream bed.

Taxon A taxonomic group of any rank.

Temporary threshold shift (TTS) The component of threshold shift which shows progressive reduction with the passage of time, when the apparent source has been removed.

Threshold of hearing For a given listener (or species) the lowest sound pressure level of a particular sound that can be heard under specific measurement conditions.

Threshold shift The deviation, in decibels, of a measured hearing level from one previously established.

T noise level The period in hours over which construction noise will be produced.

T-POD porpoise detector a static hydrophone unit that filters out and records all but the clicks emitted by Harbour porpoises.

Tonal noise Sources sometimes contain pure tone components, which can be identified as hums, whistles etc. The presence of these tonal components is sometimes considered to add an extra, annoying, quality to the noise.

Turbidity Cloudiness of water caused by suspended particulate matter.

Vibration A to and fro motion; a motion which oscillates about a fixed equilibrium position.

Vibration dose value (VDV) The effect of building vibration on people inside buildings is assessed by determining their vibration dose. Present knowledge indicates that this is best evaluated with the VDV, as promoted through BS 6472. VDV defines a relationship that yields a consistent assessment of intermittent, occasional and impulsive vibration, as well as continuous input, and correlates well with subjective response. The way in which people perceive building vibration depends upon various factors, including the vibration frequency and direction. The VDV is given by the fourth root of the integral of the fourth power of the acceleration after.

Wind masking The effect of offshore structures, such as wind turbines, resulting in a decrease in wind downwind.

Zone of theoretical visibility A term used to describe the area over which a development can theoretically be seen.

References

Aarefjord, H., Bjørge, A.J., Kinze, C.C., and Lindstedt, I. 1995. Diet of the harbour porpoise (Phocoena phocoena) in Scandinavian waters. Reports of the International Whaling Commission Special Issue, 16, pp 211 - 222.

ABB. 2005. Fast forward with ABB Power Technology, spring 2005.

Abdullah, M.I. and Royle, L.G. 1973. Chemical evidence for the dispersal of the River Mersey run off in Liverpool Bay. Estuarine and Coastal Shelf Science. Vol 1, pp 401 – 409.

ABPmer. 2005. Measurement of scour at the North Hoyle Offshore Wind Farm. A report to npower renewables.

Anatec. 2005. Maritime traffic survey. Gwynt y Môr Wind Farm. Anatec UK Ltd.

Apprahamian, M.W. and Apprahamian, C.D. 1990. Status of the genus Alosa in the British Isles; past and present. J Fish Biol. 37 (supplement A), pp 257 – 258.

Arnold, H., Bartels, B., Wilson, B., and Thompson, P. 1997. The bottlenose dolphins of Cardigan Bay: Selected biographies of individual bottlenose dolphins recorded in Cardigan Bay, Wales. Report to Countryside Council for Wales. CCW Science Report No. 209.

Association of British Insurers. 2004. A changing climate for insurance;

Bagliniere, J.L. and Maiss, G. 1998. Biology and ecology of brown sea trout. John Wiley and Sons, Chichester and New York.

Baines. 2003. Sightings in Wales Issue 4 – Summer 2003. CCW and Sea Watch Foundation.

Bamber, R.N. 1988. A survey of the intertidal soft-sediment fauna of the Mersey Estuary, March 1987. Unpublished, Central Electricity Generating Board (Reports Group Report, No. RD/L/3338/R88).

Berrow, S.D., Long, S.C., McGarry, A.T., Pollard, D., Rogan, E., and Lockyer, C. 1998. Radionuclides (137Cs and 40K) in harbour porpoises Phocoena phocoena from British and Irish coastal waters. Marine Pollution Bulletin, 36, pp 569 - 576.

BGS. 1995. In Barne et al (eds), Coasts and seas of the United Kingdom, Region 12 Wales: Margam to Little Orme and Region 13 Norther Irish Sea: Colwyn Bay to Stranraer including the Isle of Man. JNCC, Peterborough.

BHP Billiton Petroleum Ltd. 2001. Liverpool Bay oil and gas production operations environmental statement. Mid 2001 Edition. Document No: H-000-BR-030 Rev. 2. September 2001.

BHP Billiton. 2005. Liverpool Bay Operations Data (website www.bhpbilliton.com)

Bjørge, A., & Øien, N. 1995. Distribution and abundance of harbour porpoise, Phocoena phocoena, in Norwegian waters. Report of the International Whaling Commission, Special Issue No. 16, pp 89 - 98.

BMAPA & English Heritage, 2003, Marine Aggregate Dredging and the Historic Environment: guidance note. British Marine Aggregate Producers Association and English Heritage, London

Bowden. 1980. In ABPmer. 2005. Gwynt y Môr Offshore Wind Farm: Coastal process study – Phase 1. Determining scope. Report R.1177.

Briggs, C.S. (ed) 2003. Towards a research agenda for Welsh archaeology. BAR British Archaeology Series 343.

Brodie, P.F. 1995. The Bay of Fundy/Gulf of Maine harbour porpoise (Phocoena phocoena): Some considerations regarding species interactions, energetics, density dependence and bycatch. Reports of the International Whaling Commission Special Issue, 16, pp 181–187.

BWEA (1994). Best Practice Guidelines for Wind Farm Development.

BWEA (2004) Why Wind? Published by BWEA and available from www.bwea.com

BWEA 2004. Recommendations for Fisheries Liaison.

BWEA (http://www.bwea.com/edu/calcs.html)

BWEA 2005. (http://www.bwea.com/media/news/kyoto.html)

Camacho-Ibar, V.F., and McEnvoy, J. 1996. Total PCBs in Liverpool Bay sediments. Marine Environmental Research. Vol 41, pp 241 – 263.

Camacho-Ibar, V.F., Wrench, J.J. and Head, P.C. 1992. Contrasting behaviour of arsenic and mercury in Liverpool Bay sediments. Estuarine and Coastal Shelf Science. Vol 34, pp 23–26.

Camacho-Ibar, V.F., Wrench, J.J. and Head, P.C. 1992. Contrasting behaviour of arsenic and mercury in Liverpool Bay sediments. Estuarine and Coastal Shelf Science. Vol 34, pp 23–26.

Camphuysen, C.J., Fox, A.D., Leopold, M.F., and Petersen, I.K. 2004. Towards standardersied seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the UK. COWRIE – BAM – 02 – 2002.

CCME, 2001. Canadian sediment quality guidelines for the protection of aquatic life. Canadian environmental quality guidelines, Canadian Council of Ministers for the Environment, Winnipeg, Canada.

CCW, 2001. Guide to Best Practice in Seascape Assessment.

CCW, 2002. Development of the methodology of the assessment of cumulative effects of marine activities using Liverpool Bay as a case study. Oakwood Environmental 2002.

CCW. 2004. Countryside Council for Wales (CCW) Phase 1 – Intertidal Survey – Standard Report. 11.55.2 Arfon Clwyd to Llanddulas.

CCW, 2005. http://www.ccw.gov.uk/protected_sites/

CEFAS, 2002. Guidance notes for EIA in respect of FEPA/CPA requirements

CEFAS, 2004 . Offshore wind farms. Guidance note for environmental impact assessment in relation to FEPA and CPA requirements. V2 June 2004.

CEFAS. 2001. Fisheries Information – cod, whiting, plaice and sole in the Irish Sea. EU Study Contract 99-009.

CEFAS. 2004. Fish Stock Management.

Census, 2001 www.statistic.gov.uk/census2001

CFCM, 2005(a). A strategic environmental assessment of the fish and shellfish resources with respect to proposed offshore wind farms in the eastern Irish Sea. Stephen J Lockwood

CFCM, 2005(b). Gwynt y Môr Offshore Wind Farm Technical Report. Commercial recreational fisheries in Liverpool Bay. Stephen J Lockwood

Christensen, et al 2004. Visual and radar observations of birds in relation to collision risk at the offshore wind farm at Horns Rev.

Clwyd Landscape Assessment, 1995

CMACS and Cranfield (in preparation). The potential effects of electromagnetic fields generated by sub-sea power cables associated with offshore wind farm developments on electrically and magnetically sensitive marine organisms – a review. Report for COWRIE. EM Field 2-06-2004.

CMACS. 2001. North Hoyle Windfarm Baseline Survey Technical Report.

CMACS. 2002. Burbo Offshore Wind Farm Environmental Impact Assessment – technical report marine ecology. Report produced for Seascape Energy Ltd. Centre for Marine and Coastal Studies, ERC, University of Liverpool.

CMACS. 2002. North Hoyle Offshore Wind Farm Environmental Impact Assessment Technical Report Marine Sediments.

CMACS. 2003. A baseline assessment of electromagnetic fields generated by offshore wind farm cables. COWRIE Report EMF-01-2002.

CMACS. 2003. Measurements of the water quality at Rhyl during the installation of the cable beach crossing for the North Hoyle Offshore Wind Farm. A report to npower renewables.

CMACS. 2004. North Hoyle monitoring report. A reportr to npower renewables. J3002/05/05.

CMACS. 2004. North Hoyle Offshore Wind Farm environmental monitoring of suspended sediments during installation of a meterological mast.

CMACS. 2005. Gwynt y Môr Offshore Wind Farm - marine benthic survey report 2005.

CMACS. 2005. Gwynt y Môr Offshore Wind Farm Technical Report. CMACS Ltd, Birkenhead, UK.

Collings, S.E., Johnson, M.S. and Leah, R.T. 1996. Metal contamination of angler-caught fish from the River Mersey. Marine Environmental Research. Vol 41, pp 281 – 297.

Connor, D.W., Allen, J.H, Golding, N., Howell, K.L., Lieberknecht, L.M., Northern, K.O., and Reker, J.B. 2004. The marine habitat classification for Britain and Ireland. Version 04.05. Joint Nature Conservation Committee, Peterborough.

Connor, D.W., Dalkin, M.J., Hill, T.O., Holt, R.H.F, and Sanderson, W.G. 1997. Marine biotope classification for Britain and Ireland. Vol 2. Sublittoral biotopes. Version 97.06. JNCC Report No 230. Joint Nature Conservation Committee, Peterborough.

Conwy Unitary Development Plan (Draft). 2001.

CORDAH. 2003. Offshore wind energy generation: Phase 1 proposals and environmental report. Prepared for the Department of Trade and Industry by BMT CORDAH Ltd, Pennycuik, Midlothian. (www.og.dti.gov.uk/offshore-wind-sea/process/responses/EN_030603.pdf)

Coull, K.A., Johnstone, R. and Rogers, S.I. 1998. Fisheries sensitivity maps in British waters. UKOOA Ltd, Aberdeen (www.oilandgas.org.uk/issues)

Coull, K.A., Johnstone, R., and Rogers, S.I. 1998. Fisheries Sensitivity Maps in British Waters, UKOOA Ltd.

Cranswich, P. A., Hall, C., and Smith, L. 2004. All wales common scoter survey report 2002/2003

Crown Estate and British Marine Aggregate Producers Association (BMAPA). 2004. Marine Aggregate Dredging 2003; The area involved - 6th annual report.

Crown Estates. 2005.

http://www.thecrownestate.co.uk/40_aggregates_04_02_07.htm

Defra, 2002 (www.defra.gov.uk/environ/fcd/futurecoast)

Defra. 1999. The bass (specified areas) (prohibition of fishing) (variation) order 1999.

Defra. 2000. Quality status report of the marine and coastal areas of the Irish Sea and Bristol Channel. Department for Environment, Food and Rural Affairs Report. www.defra.gov.uk/environment/marine/quality/05.htm.

Defra. 2005. Chapter 5: The Irish Sea. In Report 5: Integrated regional assessment charting progress – an integrated assessment of the state of the United Kingdom seas. Department of Environment, Food and Rural Affairs. Pp 93 – 112.

Defra. 2005. Charting Progress: An integrated assessment of the state of UK Seas.

Denbighshire County Council Unitary Development Plan 2011. Adopted July 2002.

Denbighshire County Council, 2003. Denbighsire Landscape Strategy,

Department for Environment, Food and Rural Affairs. 2005. Nature conservation guidance on offshore windfarm developments.

Department for the Environment, Transport and the Regions (DETR); Ministry of Agriculture, Fisheries and Food; Scottish Executive Rural Affairs Department; Department of Agriculture and Rural Development (Northern Ireland); National Assembly for Wales Environment Division; Department of the Environment in Northern Ireland. 2000. A UK Conservation Strategy for the Harbour Porpoise (Phocoena phocoena). Department of Environment, Transport and the Regions,London.

Department of Transport, 1993: Design Manual for Roads and Bridges. Volume 10. Environmental Design, Section 1. The Good Roads Guide - New Roads. Part 1. Landform and Alignment, HMSO, London

DETR. 2000. Climate Change - the UK Programme.

DfT, 2002 (www.dft.gov.uk)

Dietz, R., Teilmann, J., Henricksen, O.D., and Laidre, K. 2001. Satellite tracking as a tool to study potential effects of offshore wind farms on seals at Rødsand - Technical Report. Ministry of the Environment and Energy, Denmark (in english) pp.43.

DIFRES. 2002. Investigations on the artificial reef effects of fish from marine wind turbine park at Horns Reef. Contract Number 69 (11-06-01): 2001/C231/10, Danish Institute for Fisheries Research, Charlottenlund. www.hornsrev.dk/miljoeforhold/miljoerapporteur/2-status_investigations.

Doody, J.P. 1995 (or 1989?). Conservation and development of the coastal dunes in Great Britain. In Perspectives in coastal dune management, pp 53 – 67.

Draft Ministerial Interim Planning Policy Statement On Renewable Energy (June 2004)

DTI. 1999. New and Renewable Energy Prospects for the 21st Century, 1999

DTI and MCEU. 2004. Guidance Notes: Offshore Wind Farm Consents Process.

DTI. 2005. Our energy future – creating a low carbon economy.

Duck, C.D. 1996. 5.14 Seals. In: Coasts and Seas of the United Kingdom - Region 13, Northern Irish Sea Colwyn Bay to Sranraer including the Isle of Man Eds: Barne, J.H, Robson, C.F, Kaznowska, S.S, Doody, J.P, Davidson, N.C. Joint Nature Conservation Committee, Peterborough.

EA. 2005. Environment Agency Wales 2004 Bathing waters report. Monitoring, assessment and report team. Data information and environmental assessment section.

EAB. 2005 Environmental Advisory Board, Merseyside. Personal communication.

e-Digest of Environmental Statistics, 2005 (www.defra.gov.uk/environment/statistics/)

Edwards, M. and John, A.W.G. 1996. Chapter 4.3 Plankton. In Coasts and seas of the United Kingdom. Region 13 Northern Irish Sea: Colwyn Bay to Stranraer, including the Isle of Man. Ed by J.H. Barne, C.F. Robson, S.S. Kaznowska, J.P. Doody and N.C. Davidson, 63-66. Joint Nature Conservation Committee, Peterborough.

Elderfield, H., Thorton, L. and Webb, J.S. 1971. Heavy metals and oyster culture in Wales. Marine Pollution Bulletin. Vol 2, pp 44 – 47.

Elliott, M., Nedwell, S., Jones, N.V., Read, S.J., Cutts, N.D., and Hemmingway, K.L. 1998. Intertidal sand and mudflats and subtidal mobile sandbanks (Volume II). An overview of dynamic and sensitivity characteristics for conservation management of marine SACs. Scottish Association for Marine Sciences, Oban, Scotland.

Ellis, J., and Parker-Humphreys, M. 2005. Rays in the Irish Sea, CEFAS Lowestoft Contract Report (C2176) prepared for Coastal Fisheries Conservation and Management (on behalf of RWE-Innogy Ltd).

Ellis, J. R., Rogers, S.I. and Freeman, S.M. 2000. Demersal assemblages in the Irish Sea, St Georges Channela dn Bristol Channel. Estuarine, Coastal and Shelf Science, 51, pp 299 – 315.

HMSO, 2004 Energy Act

English Nature, 1998 (www.english-nature.org.uk/)

English Nature, 2001 (www.english-nature.org.uk/)

English Nature, 2005. http://www.english-nature.org.uk/speciallink.htm

Environs Partnership. 2005. Gwynt y Môr Offshore Windfarm seascape and visual impact assessment.

ERM. 2002. Aggregate production licence application for Area 457. In Liverpool Bay Environmental Statement. Prepared for Westminster Gravels Ltd.

ERM. 2005. Assessment of the environmental impacts of the Gwynt y Môr Offshore Wind Farm project on birds and other terrestrial species. A report to npower renewables.

ETSU. 1999. DTI New & Renewable Energy Programme. Assessing the

ETSU. 2000. DTI Wind Information Needs for Planners.

European Commission. 2001. Concerted Action on Offshore Wind Energy in Europe.

European Commission Communication 366. 2004. The share of renewable energy in the EU Commission report in accordance with Article 3 of Directive 2001/77/EC, evaluation of the effect of legislative instruments and other community policies on the development of the contribution of renewable energy sources in the EU and proposals for concrete actions.

European Community Directive 94/69/EC. 1992. The conservation of natural habitats and of wild fauna and flora. Official Journal L206, pp 7 –50.

Evans, P.G.H. 1992b. Status Review of Cetaceans in British and Irish Waters. Report to UK Department of the Environment. Oxford, Sea Watch Foundation.

Evans, P.G.H. 1998a. Cetacean distributions in the waters around the British Isles. In: United Kingdom Digital Marine Atlas, Third Edition. Natural Environment Research Council.

Flather, R.A. 1987. Estimatyes of extreme conditions of tide and surge using a numerical model of the north-west European continental shelf. Estuarine, Coastal and Shelf Science, 24, pp 69 – 93.

Flather, R.A. 1992. Tidal range and storm surges. In The Irish Sea: Global warming and climate change – seminar report, Liverpool University Press, pp 29 – 40.

Foster, P., Voltalina, D., and Beardall, J. 1982. A seasonal study of the distribution of surface state variables in Liverpool Bay. IV. The spring bloom. Journal of Experimental Marine Biology and Ecology, 62, pp 93 – 115.

Fox, C.J., Dickey-Collas, M., and Winpenny, A.J. 1997. Spring plankton surveys of the Irish Sea in 1995: the distribution of fish eggs and larvae. Sci. Ser. Tech. Rep., CEFAS Lowestoft, 104.

Friends of the Earth Cymr. 2002. Attitude survey.

Gannon, D.P., Craddock, J.E., and Read, A.J. 1998. Autumn food habits of harbor porpoises, Phocoena phocoena, in the Gulf of Maine. Fishery Bulletin, 96, pp 428 - 437.

Garwood, P., and Foster-Smith, R. 1991. Intertidal survey from Rhos Point to New Brighton. Nature Conservancy Council, CSD Report, No 1, 194.

Gifford and Partners Ltd. 2005a. Gwynt y Môr Wind Farm – Recreational Diving Technical Report

Gifford and Partners Ltd. 2005b. Gwynt y Môr Offshore Wind Farm Cultural Heritage Technical Report.

Goold, J.C., Calderan S.V. and Goold L.L. 2005. Baseline visual and acoustic marine mammal surveys at Gwynt y Môr. Final Report to npower renewables, June 2005. University of Wales, Bangor.

Greenpeace, 2000. The Future of the UK Offshore Industry

Green M. 2005a. Gwynt-y-Mor Offshore Wind Farm - Grid Connection Bird Surveys: Wintering Birds. April 2005.

Green M. 2005b. Gwynt-y-Mor Offshore Wind Farm - Grid Connection Bird Surveys: Breeding Birds. June 2005

Grossman, G.D., Jones, G.P. , and Seaman, W.J. 1997. Do artificial reefs increase regional fish production? A review of existing data. Fisheries, 22, pp 17 – 23.

Habitats Directive Technical Advisory Group on Water Quality (HDTAGWQ). 2001. Interim guidance on sediment quality guidelines for use in the assessment of the potentila impact of chemicals detected in sediments at SAC/SPA sites. Prepared by Helen Wilkinson.

Hammond, P.S., Berggren, P., Benke, H., Borchers, D.L., Collet, A., Heide-Jorgensen, M.P., Heimlich, S. Hilby, A.R., Leopold, M.F., and Oien, N. 2002. Abundance of harbour porpoise and other cetaceans in the North Sea and adjacent waters. Journal of Applied Ecology, 39, pp 361 – 376.

Hammond, P.S., Northridge, S.P., Thompson, D., Gordon, J.C.D., Hall, A.J., Aarts, G., and Matthiopoulos, J. 2005. Background information on marine mammals for strategic environmental assessment 6, Report to the Department of Trade and Industry.

Harbour Works (Environmental Impact Assessment) Regulations. 1999. (SI 1999/3445).

Hastings, M.C., Popper, A.N, Finneran, J.J., and Lanford, P.J. 1996. Effect of low frequency underwater sound on hair cells of the inner ear and lateral line of the teleost fish Astronotus ocellatus. J. Acoust. Soc. Am. 99, pp 1759 – 1766.

Heaps, N.S. 1972. Estimation of density currents in the Liverpool Bay area of the Irish Sea. Geophysics Journal Royal Astronomical Society, 30, pp 415 – 432.

Hillis, J.P., and Grainger, R.J.R. 1990. The exploited species. In Norton, T.A., and Geffen, A.J. Irish Sea Study Group Report Part 3 – Exploitable living resources. Liverpool University Press.

Hoare Lee. 2005. Gwynt y Môr Offshore Wind Farm Noise Impact Assessment.

Hoek, W. 1992. An unusual aggregation of harbour porpoises (Phocoena phocoena). Marine Mammal Science, 8, pp 152 - 155.

Hoffman, E., Astrup, J., Munch-Petersen, S., and Strottrup, J. 2000. The effects of marine wind farms on the distribution of fish, shellfish and marine mammals in the Horns Rev area. Baggrundsrapport, 24. Report to Elsamprojekt A/S. Danish Institute for Fisheries Research.

Holt, T.J., and Shalla, S.H.A. 2001. Baseline survey in support of the development of hydrocarbon production at BHP's Hamilton East site, Liverpool Bay. A report to BHP Petroleum Ltd, C2581/11-01 v.1.

Holt, T.J., Rees, E.I., Hawkins, S.J., and Seed, R. 1998. Biogenic reefs (Volume IX). An overview of dynamic and sensitivity characteristics for conservation management of marine SACs. Scottish Association for Marine Sciences (UK Marine SACs Project), Oban, Scotland.

http://www.wales.gov.uk/keypubstatisticsforwales/content/publication/housing/2005/sb2-2005/sb2-2005.htm

http://www.welshyachtingassociation.org.uk/

Hughes, K. 1998. The status of the harbour porpoise (Phocoena phocoena) in UK waters. MSc thesis, University of Greenwich, London.

Hui, C.A. 1979. Undersea topography and the distribution of dolphins of the genus Delphinus in the southern California Bight. Journal of Mammalogy, 60, pp 521 - 527.

Innogy. 2002. North Hoyle Offshore Wind Farm: Environmental Statement. NWP Offshore Ltd., Bourne End.

IPCC (1995)

IPCC (2001) Regional impacts of climate change special report

JNAPC, 1993. Maritime cultural heritage and seabed development code of practive

JNCC. 1999. Coasts and seas of the United Kingdom: Region 13. Coastal Directories, JNCC, Peterborough.

JNCC. 2003. Irish Sea Pilot, Issue 2, March 2003.

JNCC. 2004. Guidelines for minimsing accoustic disturbance to marine mammals from seismic surveys.

www.jncc.gov.uk/pdf/seismic_survey_guidelines_200404.pdf

JNCC. 2004. www.jncc.gov.uk/protectedsites/sacselection/SAC_species.asp

JNCC. 2005. http://www.jncc.gov.uk/page-4

Johnston, C. M., Turbull, C. J., Tasker, M. L. 2002. Natura 2000 in UK offshore waters – advice to support the implementation of the EC habitats and birds directives in UK offshore waters.

Jones, N.S. 1950. Marine Bottom Communities. Biological Reviews, 25, pp 283 – 313.

Kaiser, 2003 Predicting the displacement of common scoter Melanitta nigra from benthic feed areas due to offshore wind farms. COWRIE interim report

Kaiser, 2004 Predicting the displacement of common scoter Melanitta nigra from benthic feed areas due to offshore wind farms. COWRIE interim report

Kaiser, M.J., and Spencer, B.E. 1996. The effects of beam trawl disturbance on infaunal communities in different habitats. Journal of Animal Ecology, 65, pp 348 – 358.

Keddie, R.G. 1998 Chapter 7: Coastal protected sites. In Coasts and seas of the United Kingdom. Region 13 Northern Irish Sea: Colwyn Bay to Stranraer, including the Isle of Man, JNCC, Peterborough.

Kenyon, N.H., and Cooper, B. 2004. Sand banks, sand transport and offshore wind farms.

Komedeur, et al. 1992. Manual for aeroplane and ship surveys of waterfowl and seabirds. IWRB Special Publication, No 19

Lambeck, K. 1991. Glacial rebound and sea level change in the British Isles. Terra Nova, 3, pp 379 – 389.

Leah, R.T., Collings, S.E., Johnson, M.S. and Evans, S.J. 1993. Mercury in plaice (Pleuronectes platessa) from the sludge dispoal ground of Liverpool Bay. Marine Pollution Bulltin, 26 (8), pp 436 – 439.

Leah, R.T., Evans, S.J., and Johnson, M.S. 1992. Arsenic in plaice (Pleuronectes platessa) and whiting (Merlangius merlangus) from the north east Irish Sea. Marine Pollution Bulletin, 24, pp 544 – 549.

Lewis, E.J. 1992. Social cohesion and residency of bottle-nosed dolphins (Tursiops truncatus) in west Wales. An analysis of photographic data. BSc Thesis, University of Leeds. p 31.

Lockwood, S.J. 2005. An environmental assessment of the fish and shellfish resources with respect to proposed offshore wind farms in the eastern Irish Sea. Coastal Fisheries Conservation and Management, Colwyn Bay. A report for the Eastern Irish Sea Developers' Group, npower rewables, Reading, UK.

Mackie, A.S.Y. 1990. Offshore benthic communities of the Iirish Sea. In The Irish Sea: an environmental review. Part 1. Nature conservation, ed. Irish Sea Study Group, Liverpool University Press, pp 169 – 218.

MAFF. 1990. Bass – nursery areas and other conservation measures. Ministry of Agriculture, Fisheries and Food, London.

MAFF. 1991. Monitoring and surveillance of non-radioactive contaminants in the aquatic environment and activities regulating the disposal of wastes at sea, 1988 – 89. Aquatic Environment Monitoring Report, MAFF Directorate of Fisheries Research, Lowestoft, 26, p 90.

MAFF. 1999. Future sea level rise, ABPmer.

Maitland, P.S., and Campbell, R.N. 1992. Freshwater fishes. The New Naturalist, Harper Collins, London.

Marine Conservation Society. 2004. Good Beach Guide.

MCA (Maritime and Coastguard Agency). 2004. Proposed UK offshore renewable energy installations (OREI) – Guidance on navigational safety issues. Marine Guidance Note 275.

Merseyside partnership 2005 Digest of Liverpool and Merseyside Tourism Statistics May 2005

Mills, D.H. 1989. Ecology and management of atlantic salmon. Chapman and Hall, London.

Moore, J. 2002. An atlas of marine biodiversity action plan species and habitats and species of conservation concern in Wales. Second Edition. CCW contract science report no. 509.

Moriarty, C. 2000. The European eel. Buckland Occassional paper 6, Buckland Foundation.

Motyka, J.M., and Brampton, A.H. 1993. Coastal management: Mapping of littoral cells. HR Wallingford, Report SR 328.

MPMMG (Marine Pollution Monitoring Management Group). 1998. National Monitoring Programme Survey of the Quality of UK Coastal Waters. Aberdeen.

Mueller, R.P., Neitzel, D.A., and Mavros, W.V. 1998. Evaluation of low and high frequency sound for enhancing fish screening facilities to protect outmigrating salmonids. Report by Pacific Northwest National Laboratory, Richmond, Washington, US for US Dept. Energy.

NATO. 2002. http://enterprise.spawar.navy.mil/nepa/whales/doc2-7

Natural Environment Research Council. (NERC). 1998. Cetacean distributions in the waters around the British Isles. In United Kingdom Digital Marine Atlas (UKDMAP) Third Edition.

Neal, K.J. 2004. Crangon crangon. Brown Shrimp. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme (on-line). Plymouth, Marine Biological Association of the United Kingdom. http://www.marlin.ac.uk/speciies/Crangoncrangon.htm.

Nedwell, J., Langworthy, J., and Howell, D. 2004. Measurements of underwater noise during construction of offshore wind farms and comparison with background noise. COWRIE report no 544 R0411.

NGT, 2004. National Grid Transco's Seven Year Statement of 2004

Nichols, J.H., Haynes, G.M., Fox, C.J., Milligan, S.P., Brander, K.M., and Chapman, R.J. 1993. Spring plankton surveys of the Irish Sea in 1982, 1985, 1987, 1988 and 1989: Hydrography and the distribution of fish eggs and larvae. MAFF Directorate of Fisheries Research, Lowestoft. Fisheries Technical Report, 95, pp 1 –111.

Northridge, S.P., Tasker, M.L., Webb, A., and Williams, J.M. 1995. Distribution and relative abundance of harbour porpoises (Phocoena phocoena L.), white-beaked dolphins (Lagenorhynchus albirotris Gray), and minke whales (Balaenoptera acutorostrata) around the British Isles. ICES Journal of Marine Science, 52, pp 55–66.

Norton, M.G., Jones, P.G.W., Franklin, A. and Rowlatt, S.M. 1984. Water quality studies around the sewage sludge dumping site in Liverpool Bay. Estuarine and Coastal Shelf Science, Vol 19, pp 53–67.

Norton, M.G., Rowlatt, S.M. and Nunny, R.S. 1984. Sewage sludge dumping and contamination of Liverpool Bay sediments. Estuarine and Coastal Shelf Science, Vol 19, pp 69–97.

npower renewables. 2004. Gwynt y Môr Offshore Wind Farm Scoping Report.

NWP Offshore Ltd. 2002. North Hoyle Offshore Wind Farm Environmental Statement.

Oakwood Environmental Ltd. 2002. Development of a methodology for the assessment of cumulative effects of marine activities using Liverpool Bay as a case study. CCW contract science report no 522.

Offshore Wind Farms: Guidance Note for Environmental Impact Assessment in Respect of FEPA and CPA Requirements (2004)

Ogawa, Y. 1986. Fish aggregation to artificial reef. Fishery Enhancement, Vol 7, pp 3 – 21.

Oliver, F, Robinson, P and Harrod, C (2001) Common Scoter Melanitta nigra survey in Liverpool Bay. Countryside Council for Wales, Bangor. CCW Science Report No. 470.

Olsen, S., and Valdermarsen, J.W. 1977. Fish distribution studies around offshore installations. ICES (mimeo) C.M.B. 41.

ONS. Office of National Statistics. 2003 Norris New Earnings Survey

Osiris. 2003a. North Holye II Proposed Offshore Wind Farm development geophysical surveys.

Osiris. 2003b. Gwynt y Môr Proposed Offshore Wind Farm development geophysical surveys – Phase I. Report No C3008.

Osiris. 2004. Gwynt y Môr Offshore Wind Fram development geophysical surveys – Phase II. Report No C4009.

OSPAR, 2000. Quality status report 2000, Region III – Celtic Seas, OSPAR Commission, London.

Parker-Humphreys, M. 2004. Distribution and relative abundance of demersal fishes from beam trawl surveys in the Irish Sea 1993 – 2001. Sci. Ser. Tech. Rep. CEFAS, Lowestoft.

Parsons, N., and Pugh, T.M. 1979. Notes on the ecology of the Clwyd Estuary, North Wales. Journal of Natural History, 13, pp 725 – 734.

Pawson, M.G., Pickett, G.D., and Walker, P. 2002. The coastal fisheries of England and Wales, Part IV: A review of their status 1999 – 2002. Sci. Ser. Tech. Rep., CEFAS, Lowestoft, 116.

Pearson, W.H.M., Skalski, J.R., and Malme, C.I. 1992. Effects of sound from geophysical survey devices on behaviour of captive rock fish (Sebastes spp.). Canadian Journal of Fisheries and Aquatic Science, 49, pp 1343 – 1356.

Picket, G., and Pawson, M.G. 1994. Sea bass: biology, exploitation and conservation, Chapman and Hall, London.

Planning Guidance (Wales). 2000. Technical Advice Note (TAN) 11 – Noise, October 1997.

Planning Guidance (Wales). 2000. Technical Advice Note (TAN) 8 – Renewable Energy, November 1996.

Planning Policy Wales, National Assembly for Wales, March 2002

POL. 2005. Proudman Oceanic Laboratory

Pollitt, M.S., Hall, C., Holloway, S.J., Hearn, R.D., Marshall, P.E., Musgrove, A.J., Robinson, J.A. & Cranswick, P.A. (2003) The Wetland Bird Survey 2000-01: wildfowl and wader counts. BTO/WWT/RSPB/JNCC, Slimbridge.

PPG22; House of Lords Select Committee Report HL Paper 78-1, 1999 (Chapter 1)

Preston, A., Jefferies, D.F., Dutton, J.W.R., Harvey, B.R., and Steele, A.K. 1972. British Isles coastal waters: The concentration of selected heavy metals in sea water, suspended matter and biological indicators – a pilot survey. Environmental Pollution, Vol 3, pp 69 – 82.

Qinetiq. 2005. An assessment of the impact of the proposed Gwynt y Môr offshore wind farm on marine radio navigation and communication systems.

RBA Research. 2004. Report from survey carried out on behalf of npower rewables.

Read, A.J. 1999. Harbour Porpoise - Phocoena phocoena (Linnaeus, 1758). In Ridgeway, S., and Harrison, R.H. eds, Handbook of Marine Mammals, Vol 6 Academic Press, pp 323 - 355.

Featherstone, N and Lambie, P. 2004. Reed's Nautical Almanac.

Rees, E.I.S, Walker, A.J.M., and Ward, A.R. 1972. Benthic fauna in relation to sludge disposal. In Out of Sight: Out of mind. Report of a working party on the disposal of sludge in Liverpool Bay, Volume 2: Appendices. Department of the Environment, London, pp 229 – 343.

Rees, E.I.S. 2001. Habitat specialisation by Thia scutellata (Decapoda: Brachyura) off Wales. Journal of the Marine Biological Association of the UK, 81 (4), pp 697 – 698.

Rees, E.I.S., and Walker, A.J.M. 1984. Macrobenthos community and population monitoring studies around the dumping ground. In Sewage sludge disposal in Liverpool Bay. Research into effects 1975 to 1977, Part 2 Appendices. Water Technical Division, department of the Environment, London, pp 113 – 163.

Reeves, R.R., Stewart, B.S., Clapham, P.J., and Powell, J.A. 2002. Sea mammals of the world. A&C Black Publishers.

Regeneris. 2005. Gwynt y Môr Offshore Wind Farm socio-economic technical report.

Reid, J.B., Evans, P.G.H., and Northridge, S.P. 2003. Atlas of Cetacean distribution in the northwest European waters. JNCC.

Rice, K.A., and Putwain, P.D. 1987. The Dee and Mersey Estuaries. Environmental Background Environmental Advisory Group, Shell UK.

Robinson, Paul. 2005. Personal communication. Gavia Ecology.

Rogan, E., and Berrow, S.D. 1996. A review of harbour porpoises, Phocoena phocoena, in Irish Waters. Report of the International Whaling Commission. 46 pp 595 - 605.

Rogan, E., Penrose, R., Gassner, I. Mackey, M.J., and Clayton, P. 2001. Marine mammal strandings: a collaborative study for the Irish Sea. Maritime Ireland/Wales INTERREG Report No 8.

Rogers, S.I. 1993. The dispersion of sole, Solea solea, and plaice, Pleuronectes platessa, within and away from a nursery ground in the Irish Sea. Journal of Fish Biology, Supplement A, pp 275 – 288.

Rogers, S.I. 1994. Species composition and population of sole, Solea solea, in a flatfish nursery groun on the North Wales coast, UK. Aquaculture and Fisheries Management, 25, pp 161 – 177.

Rogers, S.I., and Lockwood, S.J. 1990. Observations on coastal fish fauna during a spring bloom of Phaeocystis poucheti in the eastern Irish Sea. Journal of the marine biological Association of the United Kingdom, 70, pp 249 – 253.

Royal Commission on Environmental Pollution, 2000

Royal Yachting Association (RYA) and Cruising Association (CA). 2004. 'Sharing the Wind': Recreational Boating Use in the Offshore Wind Strategic Areas.

RPS, 2005 Environmental Statement for the London Array Offshore Wind Farm

RWE Innogy, 2004. North Hoyle monitoring report

RWE npower. 2005. Gwynt y Môr: the physical environment. Technical Report, Swindon, UK.

Sager and Sammler. 1975. In ABPmer. 2005. Gwynt y Môr Offshore Eind Fram: Coastal porcess study – Phase 1: Determining scope, Report R.1177.

SAHFOS. 1996. Continuous Plankton Recorder. Sir Alistair Hardy Foundation for Ocean Science. In Edwards, M., and John, A.W.G., Chapter 4.3, Plankton. In Coasts and Seas of the United Kingdom. Region 13, Northern Irish Sea: Colwyn Bay to Stranraer including the Isle of Man, JNCC, Peterborough, pp 83 – 87.

Sand, O., Enger, P.S., Karlsen, H.E. and Knudsen, F.R. 2001. Detection of infrasound in fish and behavioural responses to intense infrasound in juvenile salmonids and European silver eels: A mini review. American Fisheries Society Symposium, 26, pp 183 – 193.

Scott Wilson. 2005. Gwynt y Môr Wind Farm transport assessment.

Shennan, I. 1989. Holocene crustal movements and sea-level changes in Great Britain. Journal of Quaternary Science, 4, pp 77 – 89.

SMRU. 2002. Website of the Sea Mammal Research Unit. Seals in Great Britain. http://smub.st-and.ac.uk/seals_in_gb.htm.

SMS. 2005. Gwynt y Môr Offshore Winnd Farm navigation technical report.

Standard Guidance for Archaeological Desk-Based Assessment, 1999

Sustainable Development – A Better Quality of Life, 1993

The Centre for Environment Fisheries and Aquaculture Science (CEFAS). 2005. Waste Disposal Site Data.

PIU, 2002. The Energy Review of the performance and Innovation Unit, 2002.

Thomas, C.D., Cameron, A., Green, R.E., Bakkenes, M., Beaumont, L.J., Collingham, Y.C., Erasmus, B.F.N., De Siquiera, M.F., Grainger, A., Hannah, L., Hughes, L., Huntley, B., Van Jaarsveld, A.S., Midgley, G.F., Miles, L., Ortega- Huerta, M.A., Peterson, A.T., Phillips, O., and Williams, S.E. 2004. Extinction risk from climate change. Nature, 427, p 145 - 148.

Thorton, I., Watling, H., and Darracrott, A. 1975. Geochemical studies in several rivers and estuaries used for oyster rearing. Science of the total environment, Vol 4, pp 325 – 345.

Tougaard, J., Ebbesen, I., Tougaard, S., Jensen, T., and Teilmann, J. 2003. Satellite tracking of the harbour seals on Horns Reef. Technical report to Techwise A/S, Biological papers from the Fisheries and Maritime Museum, Esbjerg, No 3.

UKBAP. 2005. http://www.ukbap.org.uk/

UKCIP02, 2002. Tyndall Centre for Climate Change. The UKCIP02 climate change scenarios

UKCIP02. 2002. Climate Change Scenarios for the United Kingdom.

UKCPC. 2003. Future Offshore – A strategic framework for the offshore wind industry.

UK Government. 1990. White Paper "This Common Inheritance".

UKHO. 1971. Co-tidal and co-range lines.

UKHO. 2004. Admiralty Tide Tables, Vol 1. The Hydrographic Office, Taunton, UK.

UNFCCC. 2004. The first ten years.

United Nations Framework Convention on Climate Change, The First Ten Years, UNFCCC 2004, and within that report are referenced to - Intergovernmental Panel on Climate Change, Climate Change 2001: Synthesis Report. Cambridge University Press, Cambridge, 2001 .

University of Newcastle, 2002.

Vagle, S. 2003. On the impact of underwater pile-driving noise on marine life, Ocean Science Productivity Division, Institute of Ocean Sciences, DFO/Pacific.

Valdermarssen, J.W. 1979. Behaviour aspects of fish in relation to oil platforms in the North Sea. ICES, C.M.B., 27.

Vella, G., Rushforth, I., Mason, E., Hough, A., England, R., Styles, P., Holt, T., and Thorne, P. 2001. Assessment of the effects of noise and vibration from offshore wind farms on marine wildlife. DTI publication number URN 01/1341.

Vincent, et al 2004

Visual Assessment of Wind Farms, 2002. Landscape Institute & Institute of Environmental Management & Assessment (LI-IEMA). 2002. Guidelines for Landscape and Visual Impact Assessment. 2nd Edition. Spon Press, London.

Welsh Tourist Board. 2005. Visits to tourist attractions 2004.

Technical Advice Notes (www.wales.gov.uk/)

Welsh Tourist Board Survey, 2003

Wernham, C.V., Toms, M.P., Marchant, J.H., Clark, J.A., Siriwardena, G.M. & Baillie, S.R. (eds.) (2002) The migration atlas: movements of the birds of Britain and Ireland. T & AD Poyser, London.

Westerberg. 1999. Impact of studies of sea-based wind power in Sweden. Lecture held at Technisse eingritte in marine Lenebsraume, Bundesant fur Naturschutz, Internationale Naturschutzkademielnuel vilm 27 – 29/10/99.

Wilson, E. 2004. Homarus gammarus. Common lobster. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme, Marine Biological Assoication of the United Kingdom, Plymouth. http://www.marlin.ac.uk/species/Homarusgammarus.htm.

World Health Organisation (WHO). 2002. Guidelines for Community Noise

WWF-UK, English Nature, RSPB, BWEA. 2001. Wind Farm development and Nature Conservation, WWF, Godalming, UK.

www.abpports.co.uk

www.bournemouth.gov.uk/Library/PDF/Living/Planning/Research/Mid%20year%20household%20estimates%202000%20to%202003.pdf

www.bwea.co.uk

www.bwea.com, July 2005

www.defra.gov.uk, 2005

www.detini.gov.uk/cgi-bin/downdoc?id=922

www.environment-agency.gov.uk, July 2005

www.ieem.org.uk/ECIA.htm

www.jncc.gov.uk

www.offshore-technology.com, 2005

www.scotland.gov.uk/Resource/Doc/933/0004175.xls

www.statistics.gov.uk/census2001/

www.thecrownestate.co.uk

www.vestas.com

www.wda.co.uk, August, 2005

Yasui, W.Y., and Gaskin, D.E. 1986. Energy budget of a small cetacean, the harbour porpoise, Phocoena phocoena (L.). Ophelia, 25, pp 183–97.

n